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MONTANA FOREST RESOURCE AND INDUSTRY STATISTICS

by

Paul D. Kemp and M. B. Dickerman

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Missoula Montana

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UNITED STATES DEPARTMENT OF AGRICULTURE
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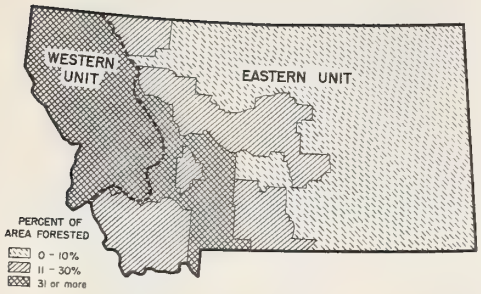
THE FOREST SURVEY IN MONTANA



In 1928 Congress authorized and directed the Secretary of Agriculture to undertake a comprehensive survey of the timber supplies of the United States. Responsibility for this survey was assigned to the Forest Service and in turn to its various regional forest experiment stations. The Northern Rocky Mountain Forest and Range Experiment Station in 1934 initiated the forest survey in Montana.

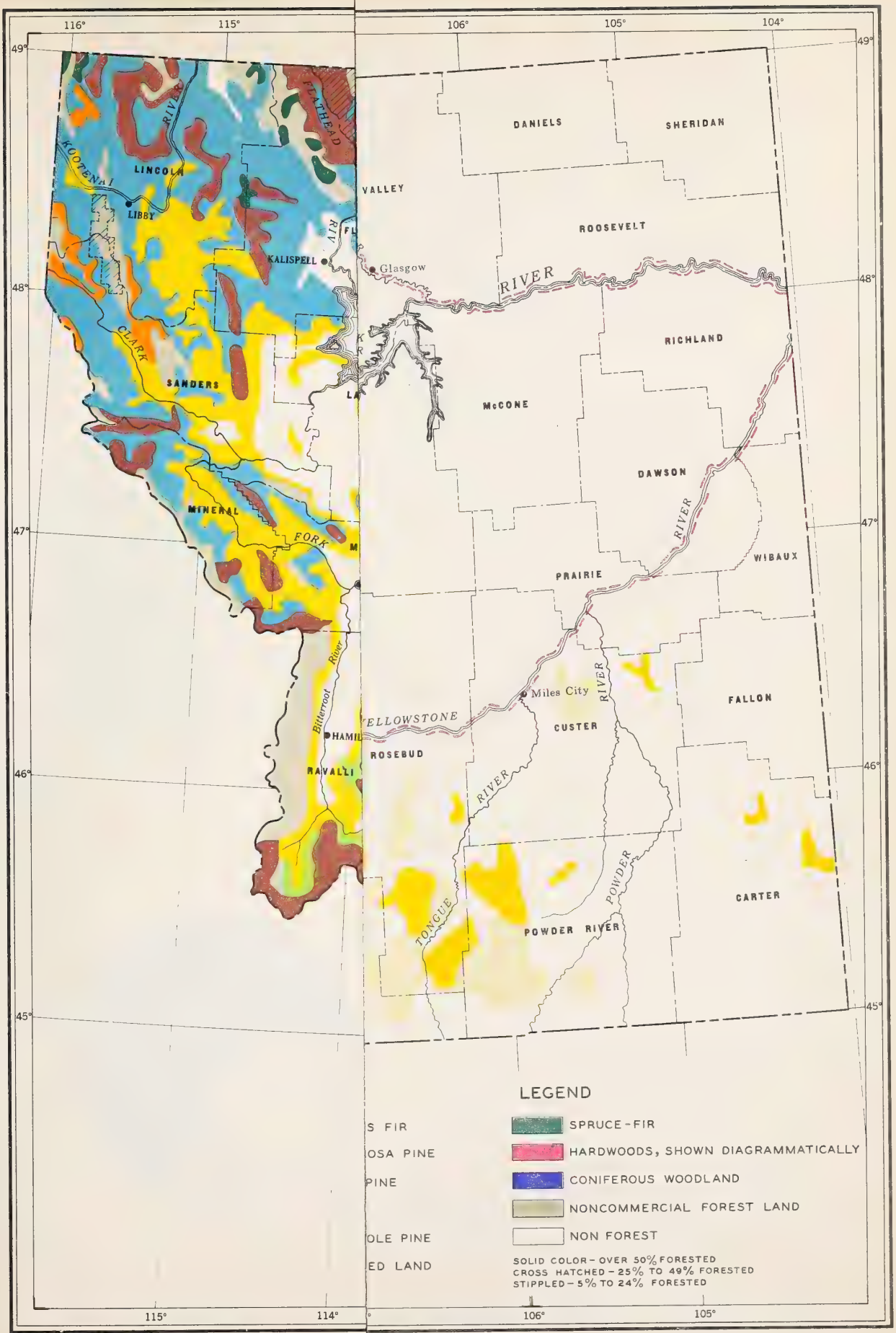
From 1934 on, until interrupted by World War II, the survey program at this station concentrated its main effort in the heavily forested counties west of the Continental Divide. As the data were compiled, statistical reports 1/ were published for each county in the Western Unit. In addition to the statistical data, the survey in the Western Unit included the preparation of detailed cover-type maps.

In the Eastern Unit, that part of the State east of the Continental Divide, field work was completed in four counties (Cascade, Chouteau, Fergus, and Judith Basin) before the survey was terminated because of the War. Statistical reports for these counties, except Cascade, were released in 1943. Cascade County was covered in a report issued in 1948.

Following World War II the forest survey was reactivated in the Eastern Unit. Because of the limited funds available for completing the work in the State, the survey method was streamlined to sample for area, volume, growth, and noncommodity drain. Field work was resumed in 1947 and completed in the fall of 1949. In this period some 8 million acres of forest land in 43 counties were sampled. Since the sampling was not intensive enough to give detailed, reliable statistics by counties, the findings were summarized by groups of counties. Four county groups were delineated: Northern (19 counties), Southern (15 counties), South Central (9 counties), and Central (4 counties). Separate statistical reports were released for the first three of these county groups.

Thus, in 1950 we have for the first time a detailed, systematic summary of Montana's timber resource. This statistical report brings together these basic data. It contains inventory data on the area of forest land, the timber volume, the current annual net growth, the average annual commodity drain, and forest industry production. A comprehensive analysis of the statistical data is being made and will be published in bulletin form.

1/ A list of reports published by the forest survey for Montana is given on page 48.



Agriculture – Missoula

MAJOR FOREST TYPES
MONTANA
1950

Scale 20 10 0 20 40 Miles

LEGEND

- DOUGLAS FIR
- PONDEROSA PINE
- WHITE PINE
- LARCH
- LODGEPOLE PINE
- RESERVED LAND

- SPRUCE-FIR
- HARDWOODS, SHOWN DIAGRAMMATICALLY
- CONIFEROUS WOODLAND
- NONCOMMERCIAL FOREST LAND
- NON FOREST

SOLID COLOR – OVER 50% FORESTED
CROSS HATCHED – 25% TO 49% FORESTED
STIPPLED – 5% TO 24% FORESTED

Agriculture Missoula

1. Land area

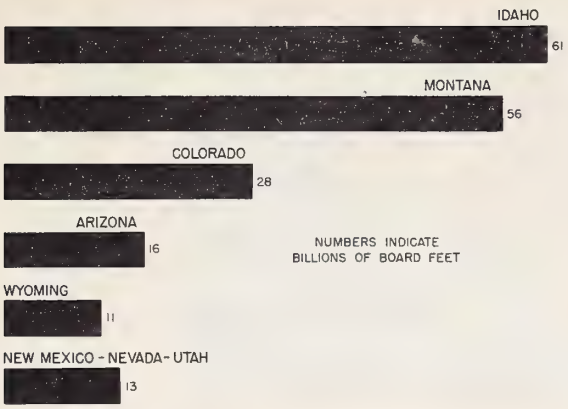
Of the 93.6 million acres of land in Montana about one fourth is forest. The total forest area is 22,359,000 acres. (See table 2.)

2. Occurrence of forest land

To study the forest situation, the State was divided into two units: Western, west of the Continental Divide, and Eastern, east of the Divide. The Western Unit has 58 percent of the forest in the State and the Eastern 42 percent. (See table 2.)

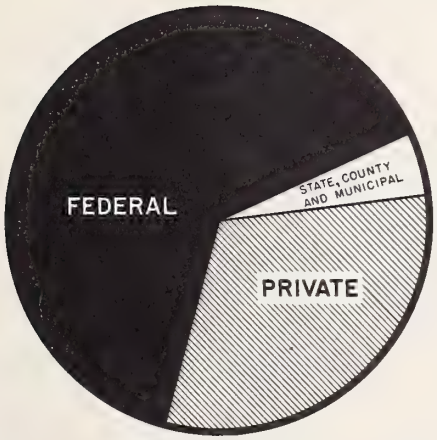
3. Classes of forest land

The 22.4 million acres of forest land in Montana is classified as follows: Commercial 71 percent, noncommercial 18, and reserved 11. (For definitions of these classes see page 42.)



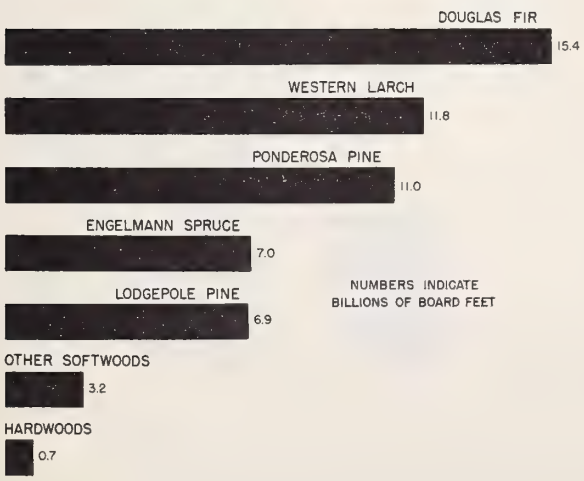
4. Saw-timber volume in Rocky Mountain states

Of the 8 Rocky Mountain states Montana ranks second in the volume of standing saw timber. Nationally, Montana ranks fifth in volume of timber, but in terms of lumber production it was eighteenth in 1947. Ninety-nine percent of the volume is in softwoods and nearly three fourths is in the Western Unit.



5. Ownership of saw timber

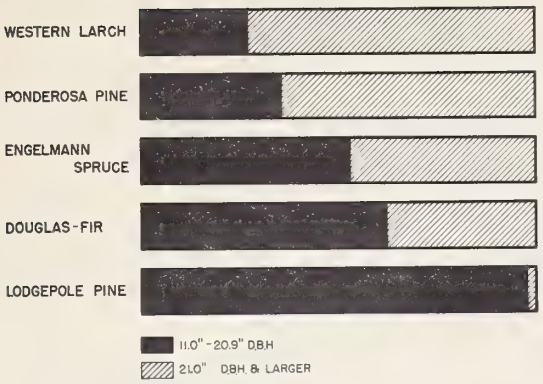
Federal ownership predominates. Sixty-five percent of all the saw timber in the State is on federal land, 30 percent on private industrial and farm holdings, and 5 percent in state and county ownership. The Forest Service manages 91 percent of the federal timber; the Indian Service, Bureau of Land Management, and other federal agencies the rest.



6. Species distribution of saw-timber volume

Just about 50 percent of the saw timber is of two species: Douglas-fir and western larch. On a cubic-foot basis lodgepole pine ranks second because of the large number of small size trees. Ponderosa pine, although making up less than one fifth of the volume, makes up about two fifths of the lumber cut.

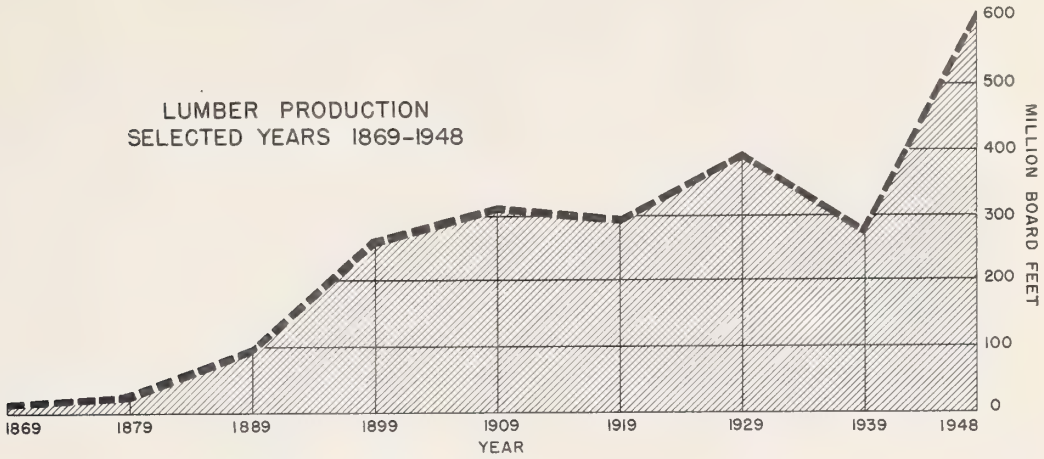
7. Size-class distribution of saw-timber trees



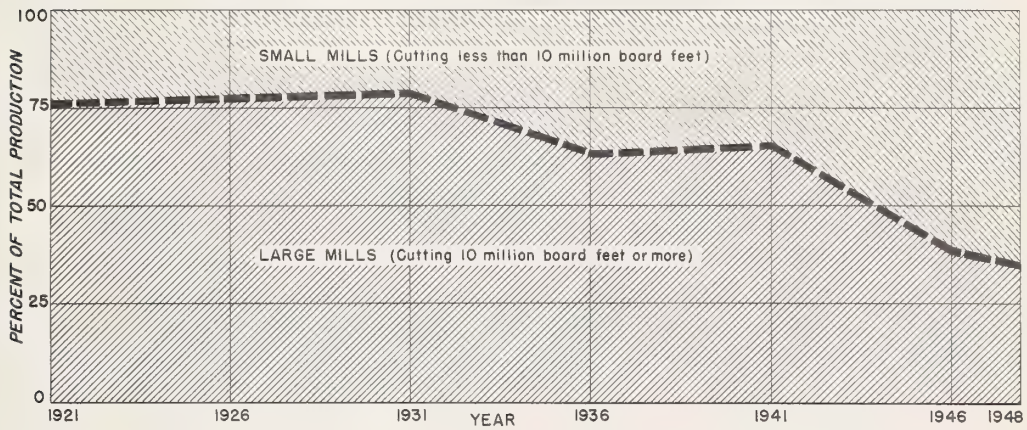
The timber in Montana is small. Fifty-three percent of the total saw-timber volume is in the small size class (11.0" to 20.9"). Marked differences occur between species. At one extreme is western larch with 28 percent in the small size class and at the other extreme is lodgepole pine with 99 percent of the volume in the small size class.

8. For all species combined the net growth exceeds the commodity drain in both board-foot and cubic-foot volume. The situation, however, is reversed for ponderosa pine where the annual drain in board-foot volume exceeds the net growth by about 78 million board feet. For the other species the favorable growth/drain relationship indicates the feasibility of increased industrial activity.

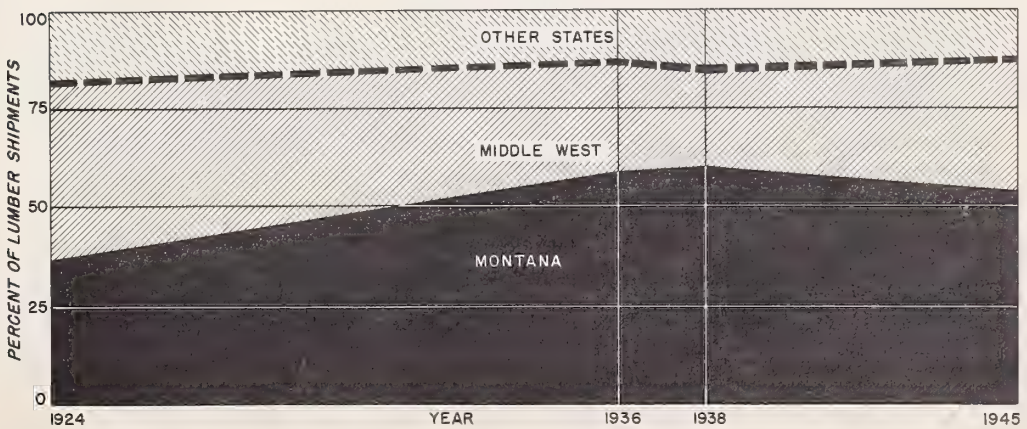
9. From some 13 million board feet in 1869 lumber production increased to 598 million in 1948. (See table 18.)



10. The lumber production pattern is changing. Small mills are cutting more of the total output, large mills less.



11. Montana is its own best customer for lumber. The middlewest states are the main market outside of the State. From 1938 to 1945 the percent of shipments to the middlewest increased.



COMPARISON OF 1949 AND EARLIER ESTIMATES

At least six different estimates have been published of Montana's timber resource in the past. (Table 1) Differences between the 1949 and earlier estimates are accounted for by (1) the sampling errors of the portion of the statistics derived by sampling 2/, (2) technique errors, (3) variations in definitions, inclusiveness, and standards of measurement, and (4) actual change. Of these, only the sampling errors are definitive. Analysis of sample variations indicate that, on the basis of odds of 2 out of 3, the sampling errors of the portion of the 1949 estimates derived by sampling lie between limits as follow: Total forest land ± 146 thousand acres, commercial forest land ± 152 thousand acres, other forest land ± 63 thousand acres, and commercial saw-timber volume ± 1,397 million board feet. Noncompensating technique errors such as misclassification and imperfect tree-volume tables affect both the sampling and complete survey statistics.

The apparent increase in total forest and commercial forest land can be at least partially accounted for by changes in definition and inclusiveness. Prior to the completion of the systematic survey in 1949 only extensive estimates were available for the area east of the Continental Divide. Hardwood areas and volumes were disregarded entirely prior to 1938. Until recently, too, with little prospect for development and use, a considerably larger portion of the total forest land area in eastern Montana was considered noncommercial. Volume estimates of 1918 and 1923 include all forest land as indicated in table 1; whereas later estimates are for commercial forests only. Part, and perhaps all, of the apparent difference between the 1945 and 1949 estimates may be accounted for by variations in minimum standards. The 1949 board-foot estimates include the saw-timber volume of trees of all species 11.0 inches d.b.h. and larger. The 1945 estimates included only pines and hardwoods to this diameter, the minimum diameter of other species being 13.0 inches d.b.h. The minimum standards for saw-timber trees were not defined for estimates prior to 1945.

For the foregoing reasons a comparison of the 1949 and previous estimates provides no definite indication of quantitive changes or trends in either direction. However, there have been changes in the character and distribution of the timber volume. The proportion of the volume in prized species such as ponderosa and white pines is diminishing and the volume of these and other species is becoming less concentrated in large blocks.

2/ Approximately one third of the forest area was derived by sampling, the remaining two thirds from complete surveys.

Table 1. Forest area and timber volume estimates. Montana, 1918-1949

Date	Forest land area			Saw-timber volume	
	Commercial	Other 1/	Total	Commercial	Total
	Thousand acres			Million feet, board measure	
1918 2/	--	--	--	--	58,000
1920 3/	13,926	--	--	--	--
1925 4/	14,696	5,926	20,622	--	50,009
1932 5/	14,865	5,821	20,686	49,796	--
1938 6/	14,613	6,074	20,687	49,793	--
1945 7/	14,758	9,480	24,238	52,515	--
1949	15,756	6,603	22,359	55,960	--

1/ Includes lands listed as noncommercial and reserved in table 2.

2/ Fifth Biennial Report of the State Forester Montana, 1917-18, p.11.

3/ U. S. Department of Agriculture, Forest Service, 1928. Statistical Bulletin No. 21. American Forests and Forest Products, 324 pp., (Capper report data).

4/ Montana State University, School of Forestry, in cooperation with the U. S. Forest Service. Montana Forest and Timber Handbook, 1926.

5/ U. S. Department of Agriculture, Forest Service, Region 1, 1931. Basic data for Senate Doc. 12, 73rd Congress, 1st Session (Copeland report).

6/ Congress of the U. S. Joint Committee on Forestry, 1941. Senate Doc. 32, 77th Congress, 1st Session (J.C.C.).

7/ U. S. Department of Agriculture, Forest Service, 1948. Basic Forest Statistics for Misc. Publ. No. 668, Forests and National Prosperity, 99 pp.

STANDARD TABLES

Tables 2 through 10 will be found in all Forest Survey state or subregional reports in order that readers may combine or compare the data with similar data for several such areas.

Table 2. Land area by major classes of forest land, Montana, 1949

Class of land	Land area		
	Western Montana	Eastern Montana	Total
	Thousand acres		
Forest land			
Commercial	8,909	6,847	15,756
Noncommercial	2,512	1,564	4,076
Reserved			
Commercial	603	467	1,070
Noncommercial	995	462	1,457
Total forest land	13,019	9,340	22,359
Nonforest land 1/	2,959	68,324	71,283
Total land	15,978	77,664	93,642

1/ Includes 171,689 acres of water according to Survey standards of area classification but defined by the Bureau of Census as land.

Table 3. Commercial forest land area by ownership class by stand-size class. Montana, 1949

Ownership class	WESTERN MONTANA Stand-size class					EASTERN MONTANA Stand-size class					MONTANA Stand-size class				
	Saw-timber	Pole	Seedling-sapling	Nonstocked & woodland	Total	Saw-timber	Pole	Seedling-sapling	Nonstocked & woodland	Total	Saw-timber	Pole	Seedling-sapling	Nonstocked & woodland	Total
	Thousand acres														
Federally owned or managed															
National forest	2,018	1,666	1,184	200	5,068	1,319	1,998	406	190	3,913	3,337	3,664	1,590	390	8,981
Indian	224	96	49	11	380	40	145	20	9	214	264	241	69	20	594
Other	48	93	28	8	177	91	203	24	151	469	139	296	52	159	646
Total federal	2,290	1,855	1,261	219	5,625	1,450	2,346	450	350	4,596	3,740	4,201	1,711	569	10,221
State	217	120	85	24	446	34	85	7	36	162	251	205	92	60	608
County and municipal	10	5	24	--	39	2	16	1	17	36	12	21	25	17	75
Private															
Farm	56	533	213	29	831	277	652	67	535	1,531	333	1,185	280	564	2,362
Industrial and other	1,167	446	271	84	1,968	196	275	33	18	522	1,363	721	304	102	2,490
Total private	1,223	979	484	113	2,799	473	927	100	553	2,053	1,696	1,906	584	666	4,852
Total all ownerships	3,740	2,959	1,854	356	8,909	1,959	3,374	558	956	6,847	5,699	6,333	2,412	1,312	15,756

Table 4. Volume of live saw timber and primary growing stock on commercial forest land by stand-size class. Montana, 1949

Stand-size class	Volume					
	Live saw timber			Primary growing stock		
	Western Montana	Eastern Montana	Total	Western Montana	Eastern Montana	Total
	Million board feet International 1/4" rule			Million cubic feet		
Saw-timber stands	34,763	11,342	46,105	6,715	3,845	10,560
Pole-timber stands	4,292	4,520	8,812	1,999	2,948	4,947
Seedling-sapling stands	596	75	671	428	78	506
Nonstocked and woodland areas	38	334	372	18	150	168
Total all stands	39,689	16,271	55,960	9,160	7,021	16,181

Table 5. Volume of live saw timber and primary growing stock on commercial forest land by ownership class. Montana, 1949

Ownership class	Volume					
	Live saw timber			Primary growing stock		
	Western Montana	Eastern Montana	Total	Western Montana	Eastern Montana	Total
	Million board feet International 1/4" rule			Million cubic feet		
Federally owned or managed						
National forest	21,655	11,489	33,144	4,904	5,075	9,979
Indian	1,961	252	2,213	399	116	515
Other	471	712	1,183	126	281	407
Total Federal	24,087	12,453	36,540	5,429	5,472	10,901
State	2,416	255	2,671	575	99	674
County and municipal	95	21	116	26	9	35
Private						
Farm	1,460	1,871	3,331	463	710	1,173
Industrial and other	11,631	1,671	13,302	2,667	731	3,398
Total private	13,091	3,542	16,633	3,130	1,441	4,571
Total all ownerships	39,689	16,271	55,960	9,160	7,021	16,181

Table 6. Volume of live saw timber and primary growing stock on commercial forest land by species. Montana, 1949

Species	Volume					
	Live saw timber			Primary growing stock		
	Western Montana	Eastern Montana	Total	Western Montana	Eastern Montana	Total
	Million board feet International 1/4" rule			Million cubic feet		
Softwoods						
Western white pine	1,119	--	1,119	237	--	237
Ponderosa pine	9,328	1,641	10,969	1,581	650	2,231
Western larch	11,760	(1/)	11,760	2,408	--	2,408
Douglas-fir	8,978	6,381	15,359	2,597	2,095	4,692
Grand fir	393	--	393	165	--	165
Alpine fir	353	257	610	88	169	257
Western redcedar	356	--	356	120	--	120
Western hemlock	171	--	171	56	--	56
Engelmann spruce	4,454	2,499	6,953	826	565	1,391
Lodgepole pine	2,496	4,451	6,947	997	3,080	4,077
White bark and limber pine	124	504	628	34	261	295
Juniper	--	--	--	1	3	4
Total softwoods	39,532	15,733	55,265	9,110	6,823	15,933
Hardwoods						
Aspen	2	14	16	11	65	76
Cottonwood	155	522	677	39	127	166
Birch	(1/)	--	(1/)	(1/)	--	(1/)
Box elder	--	1	1	--	1	1
Green ash	--	1	1	--	5	5
Willow	--	(1/)	(1/)	--	(1/)	(1/)
Elm	--	(1/)	(1/)	--	(1/)	(1/)
Total hardwoods	157	538	695	50	198	248
Total all species	39,689	16,271	55,960	9,160	7,021	16,181

1/ Less than 0.5 MM feet.

Table 7. All-timber volume on commercial forest land by kind of material. Montana, 1949

Kind of material	Volume		
	Western Montana	Eastern Montana	Total
	Million cubic feet		
Live all timber			
Primary growing stock	9,160	7,021	16,181
Secondary growing stock	144	114	258
Total	9,304	7,135	16,439
Salvable dead all timber	119	423	542
Total all timber	9,423	7,558	16,981

Table 8. Net growth and normal mortality of live saw timber and primary growing stock on commercial forest land by species group. Montana, 1949

Species group	Live saw-timber volume		Primary growing stock	
	Current annual net growth	Current annual normal mortality	Current annual net growth	Current annual normal mortality
	Million board feet		Million cubic feet	
Softwoods				
Western Montana	344	176	96	29
Eastern Montana	244	67	137	20
Total	588	243	233	49
Hardwoods				
Western Montana	2	(1/)	1	(1/)
Eastern Montana	16	(1/)	7	1
Total	18	(1/)	8	1
All species				
Western Montana	346	176	97	29
Eastern Montana	260	67	144	21
Total	606	243	241	50

1/ Less than 0.5 MM feet.

Table 9. Average annual commodity drain of live saw-timber volume and primary growing stock on commercial forest land by species group. Montana, 1939-1948

Species group	Live saw-timber volume			Primary growing stock		
	Cutting drain	Logging waste	Commodity drain 1/	Cutting drain	Logging waste	Commodity drain 1/
	-Million board feet-			-Million cubic feet-		
Softwoods						
Western Montana	440	35	475	69	11	80
Eastern Montana	26	1	27	8	1	9
Total	466	36	502	77	12	89
Hardwoods						
Western Montana	4	--	4	1	--	1
Eastern Montana	21	1	22	4	--	4
Total	25	1	26	5	--	5
All species						
Western Montana	444	35	479	70	11	81
Eastern Montana	47	2	49	12	1	13
Total	491	37	528	82	12	94

1/ Total of cutting drain and logging and milling waste.

Table 10. Average annual commodity production by timber products in cubic volume and in standard units. Montana, 1939-1948

Timber products class	Quantity						
	Cubic volume			Standard units			
	Western Montana	Eastern Montana	Total	Unit	Western Montana	Eastern Montana	Total
	M cubic feet				Number		
Sawlogs (for lumber, timbers and sawn ties)	59,020	2,373	61,393	M board feet 1/	399,201	14,120	413,321
Pulpwood logs	652	--	652	M board feet 1/	4,061	--	4,061
Pulpwood bolts	70	527	597	Standard cords 2/	811	5,919	6,730
Fuelwood	6,289	9,828	16,117	Standard cords 2/	73,128	114,279	187,407
Poles and piling	1,503	235	1,738	Pieces	107,090	18,156	125,246
Posts (round and split)	1,136	3,241	4,377	Pieces	1,058,296	3,792,778	4,851,074
Hewn ties	41	1	42	Pieces	6,020	102	6,122
Round mine timbers	3,564	1,265	4,829	Pieces	494,126	167,556	661,682
Miscellaneous	233	8	241	Cubic feet	233,444	6,841	240,285
Total all products 3/	72,508	17,478	89,986				

1/ Board feet, International 1/4" rule.

2/ Standard cords — rough wood (unpeeled). A pile of stacked wood 4 feet by 8 feet within its outside surface.

3/ Western Montana total includes 2,771 M cubic feet dead trees and eastern Montana 5,130 M cubic feet.

Table 11. Area of commercial forest land by generalized forest types and stand-size classes. Montana, 1949

Forest type	WESTERN MONTANA					EASTERN MONTANA					MONTANA				
	Stand-size class and area					Stand-size class and area					Stand-size class and area				
	Saw-timber	Pole	Seedling-sapling	Nonstocked: & woodland	Total	Saw-timber	Pole	Seedling-sapling	Nonstocked: & woodland	Total	Saw-timber	Pole	Seedling-sapling	Nonstocked: & woodland	Total
	Thousand acres														
White pine group															
White pine	156	63	93	20	332	--	--	--	--	--	156	63	93	20	332
Cedar	12	1	4	--	17	--	--	--	--	--	12	1	4	--	17
Total	168	64	97	20	349	--	--	--	--	--	168	64	97	20	349
Ponderosa pine	1,346	542	264	85	2,237	234	884	40	30	1,188	1,580	1,426	304	115	3,425
Western larch	1,338	492	622	109	2,561	--	--	--	--	--	1,338	492	622	109	2,561
Douglas-fir	357	582	140	66	1,145	859	745	44	70	1,718	1,216	1,327	184	136	2,863
Lodgepole pine group															
Lodgepole pine	199	1,204	710	52	2,165	526	1,515	321	45	2,407	725	2,719	1,031	97	4,572
White bark and limber pine	--	--	--	--	--	67	29	3	1	100	67	29	3	1	100
Total	199	1,204	710	52	2,165	593	1,544	324	46	2,507	792	2,748	1,034	98	4,672
Spruce-fir group															
Engelmann spruce	310	25	21	24	380	165	8	78	8	259	475	33	99	32	639
Hemlock-grand fir	4	4	--	--	8	--	--	--	--	--	4	4	--	--	8
Alpine fir	--	--	--	--	--	6	7	12	--	25	6	7	12	--	25
Total	314	29	21	24	388	171	15	90	8	284	485	44	111	32	672
Hardwoods	18	46	--	(1/)	64	102	186	60	2	350	120	232	60	2	414
Coniferous woodlands	--	--	--	--	--	--	--	--	800	800	--	--	--	800	800
Total	3,740	2,959	1,854	356	8,909	1,959	3,374	558	956	6,847	5,699	6,333	2,412	1,312	15,756

1/ Less than 0.5 M acres.

Table 12. Live all-timber volume on commercial forest land by kind of growing stock, species group, tree-size class, and class of material. Montana, 1949

Kind of growing stock, tree-size class, and class of material	WESTERN MONTANA			EASTERN MONTANA			MONTANA		
	Soft-woods	Hard-woods	Total	Soft-woods	Hard-woods	Total	Softwoods	Hardwoods	Total
	Million cubic feet								
Primary growing stock									
Live saw-timber trees									
Sawlog portion	5,393	27	5,420	2,589	86	2,675	7,982	113	8,095
Top portion	532	4	536	376	24	400	908	28	936
Total	5,925	31	5,956	2,965	110	3,075	8,890	141	9,031
Live pole-timber trees	3,185	19	3,204	3,858	88	3,946	7,043	107	7,150
Total primary grow. stock	9,110	50	9,160	6,823	198	7,021	15,933	248	16,181
Secondary growing stock									
Sound cull trees									
Saw-timber size	6	(1/)	6	4	--	4	10	(1/)	10
Pole-timber size	1	(1/)	1	1	--	1	2	(1/)	2
Total	7	(1/)	7	5	--	5	12	(1/)	12
Rotten cull trees	133	3	136	96	10	106	229	13	242
Limbs	--	1	1	--	3	3	--	4	4
Total secondary grow. stock	140	4	144	101	13	114	241	17	258
Grand total	9,250	54	9,304	6,924	211	7,135	16,174	265	16,439

1/ Less than 0.5 MM cubic feet.

Table 13. Volume of live saw timber on commercial forest land by diameter class groups by species. Montana, 1949

Species	WESTERN MONTANA				EASTERN MONTANA				MONTANA			
	Diameter class group				Diameter class group				Diameter class group			
	11.0-20.9" d.b.h.	21.0-30.9" d.b.h.	31.0-40.9" d.b.h.	41.0" and larger d.b.h.	11.0-20.9" d.b.h.	21.0-30.9" d.b.h.	31.0-40.9" d.b.h.	41.0" and larger d.b.h.	11.0-20.9" d.b.h.	21.0-30.9" d.b.h.	31.0-40.9" d.b.h.	41.0" and larger d.b.h.
	Million board feet, International 1/4" rule											
Western white pine	548	535	26	10	--	--	--	--	548	535	26	10
Ponderosa pine	2,230	4,829	2,050	219	1,371	264	6	--	3,601	5,093	2,056	219
Western larch	3,291	5,561	2,591	317	--	--	--	--	3,291	5,561	2,591	317
Douglas-fir	5,088	3,480	395	15	4,592	1,565	224	--	9,680	5,045	619	15
Grand fir	361	32	--	--	--	--	--	--	361	32	--	--
Alpine fir	332	21	--	--	254	3	--	--	586	24	--	--
Western redcedar	33	222	101	--	--	--	--	--	33	222	101	--
Western hemlock	68	95	8	--	--	--	--	--	68	95	8	--
Engelmann spruce	1,965	2,203	286	--	1,719	700	80	--	3,684	2,903	366	--
Lodgepole pine	2,488	8	--	--	4,369	82	--	--	6,857	90	--	--
White bark and limber pine	124	--	--	--	479	25	--	--	603	25	--	--
Cottonwood	43	107	5	(1/)	321	168	33	--	364	275	38	(1/)
Aspen	2	--	--	--	14	--	--	--	16	--	--	--
Birch	(1/)	--	--	--	--	--	--	--	(1/)	--	--	--
Box elder	--	--	--	--	1	--	--	--	1	--	--	--
Green ash	--	--	--	--	1	--	--	--	1	--	--	--
Willow	--	--	--	--	(1/)	--	--	--	(1/)	--	--	--
Elm	--	--	--	--	(1/)	--	--	--	(1/)	--	--	--
Total	16,573	17,093	5,462	561	13,121	2,807	343	--	29,694	19,900	5,805	561

1/ Less than 0.5 MM board feet.

Table 14. Net growth, normal mortality, and commodity drain on primary growing stock on commercial forest land by tree-size class. Montana, 1949

Tree-size class	Current annual net growth	Current annual normal mortality	Current annual commodity drain
	Million cubic feet		
Saw-timber trees			
Western Montana	52	26	78
Eastern Montana	42	14	9
Total	94	40	87
Pole-timber trees			
Western Montana	45	3	3
Eastern Montana	102	7	4
Total	147	10	7
All species			
Western Montana	97	29	81
Eastern Montana	144	21	13
Total	241	50	94

Table 15. Area by major classes of forest land by ownership classes. Montana, 1949

Ownership class	WESTERN MONTANA				EASTERN MONTANA				MONTANA			
	Commercial	Noncommercial	Reserved	Total	Commercial	Noncommercial	Reserved	Total	Commercial	Noncommercial	Reserved	Total
	Thousand acres											
Federally owned or managed												
National forest	5,068	2,116	1,006	8,190	3,913	1,317	503	5,733	8,981	3,433	1,509	13,923
Indian	380	95	--	475	214	23	--	237	594	118	--	712
Other	177	28	518	723	469	34	426	929	646	62	944	1,652
Total federal	5,625	2,239	1,524	9,388	4,596	1,374	929	6,899	10,221	3,613	2,453	16,287
State	446	40	--	486	162	10	--	172	608	50	--	658
County and municipal	39	1	--	40	36	5	--	41	75	6	--	81
Private												
Farm	831	50	--	881	1,531	63	--	1,594	2,362	113	--	2,475
Industrial and other	1,968	182	74	2,224	522	112	--	634	2,490	294	74	2,858
Total private	2,799	232	74	3,105	2,053	175	--	2,228	4,852	407	74	5,333
Total all ownerships	8,909	2,512	1,598	13,019	6,847	1,564	929	9,340	15,756	4,076	2,527	22,359

Table 16. Forest land area by counties

County	State unit 1/	Forest land			Total land area	Percent of total land area in forest land
		Commercial	Noncommercial and reserved	Total		
		-Acres-				--Percent--
Beaverhead	E	862,997	197,557	1,060,554	3,555,840	29.8
Big Horn	E	179,185	22,381	201,566	3,221,120	6.3
Blaine	E	80,872	6,528	87,400	2,730,880	3.2
Broadwater	E	170,777	16,260	187,037	795,520	23.5
Carbon	E	86,793	98,796	185,589	1,324,800	14.0
Carter	E	56,527	-	56,527	2,120,320	2.7
Cascade	E	234,323	84,568	318,891	1,701,120	18.7
Chouteau	E	51,037	8,521	59,558	2,508,800	2.4
Custer	E	25,092	-	25,092	2,409,600	1.0
Daniels	E	3,193	-	3,193	923,520	0.3
Dawson	E	5,952	1,160	7,112	1,509,120	0.5
Deer Lodge	W	103,524	23,898	127,422	263,480	48.4
Deer Lodge	E	79,373	50,147	129,520	208,840	62.0
Fallon	E	378	-	378	1,045,120	(2/)
Fergus	E	341,040	58,488	399,528	2,720,000	14.7
Flathead	W	1,610,082	1,294,644	2,904,726	3,313,280	88.7
Gallatin	E	528,651	224,401	753,052	1,610,880	46.7
Garfield	E	69,611	-	69,611	3,067,520	2.3
Glacier	E	110,519	289,306	399,825	1,903,360	21.0
Golden Valley	E	19,921	14,342	34,263	753,920	4.5
Granite	W	648,574	157,320	805,894	1,098,880	73.3
Hill	E	7,929	-	7,929	1,884,160	0.4
Jefferson	E	427,083	52,735	479,818	1,056,640	45.4
Judith Basin	E	211,045	84,865	295,910	1,203,200	24.6
Lake	W	444,879	91,767	536,646	960,000	55.9
Lewis & Clark	W	234,281	159,123	393,404	443,350	88.7
Lewis & Clark	E	590,409	281,029	871,438	1,782,570	48.9
Liberty	E	2,809	2,764	5,573	933,760	0.6
Lincoln	W	1,845,865	422,811	2,268,676	2,377,600	95.4
McCone	E	635	-	635	1,688,320	(2/)
Madison	E	404,695	201,032	605,727	2,259,200	26.8
Meagher	E	445,361	52,941	498,302	1,506,560	33.1

Table 16. Forest land area by counties (Cont.)

County	State unit 1/	Forest land			Total land area	Percent of total land area in forest land
		Commercial	Noncommercial and reserved	Total		
		Acres				Percent
Mineral	W	539,444	220,706	760,150	782,720	97.1
Missoula	W	1,193,795	270,607	1,464,402	1,682,560	87.0
Musselshell	E	247,381	-	247,381	1,207,040	20.5
Park	E	398,100	307,342	705,442	1,681,280	42.0
Petroleum	E	22,668	-	22,668	1,064,960	2.1
Phillips	E	26,559	2,539	29,098	3,368,960	0.9
Pondera	E	60,474	10,590	71,064	1,051,520	6.8
Powder River	E	196,791	2,189	198,980	2,102,400	9.5
Powell	W	546,554	414,209	960,763	1,495,680	64.2
Prairie	E	2,170	-	2,170	1,105,280	0.2
Ravalli	W	544,156	691,669	1,235,825	1,525,760	81.0
Richland	E	5,889	-	5,889	1,321,600	0.4
Roosevelt	E	765	-	765	1,526,400	0.1
Rosebud	E	151,941	661	152,602	3,220,480	4.7
Sanders	W	1,108,694	346,787	1,455,481	1,799,040	80.9
Sheridan	E	1,538	-	1,538	1,088,000	0.1
Silver Bow	W	88,990	16,405	105,395	235,810	44.7
Silver Bow	E	109,202	12,390	121,592	222,430	54.7
Stillwater	E	124,154	98,084	222,238	1,150,080	19.3
Sweet Grass	E	172,796	96,339	269,135	1,181,440	22.8
Teton	E	189,925	45,901	235,826	1,468,160	16.1
Toole	E	13,282	-	13,282	1,257,600	1.1
Treasure	E	24,418	-	24,418	629,760	3.9
Valley	E	14,300	-	14,300	3,252,480	0.4
Wheatland	E	25,256	28,593	53,849	912,000	5.9
Wibaux	E	5,436	-	5,436	568,960	1.0
Yellowstone	E	58,412	175	58,587	1,686,400	3.5
Yellowstone Park	E	-	139,980	139,980	172,100	81.3
Eastern Unit		6,847,664	2,492,604	9,340,268	77,664,020	12.0
Western Unit		8,908,838	4,109,946	13,018,784	15,978,160	81.5
Total		15,756,502	6,602,550	22,359,052	93,642,180	23.9

1/ W designates counties west of the Continental Divide, and E, east of the Divide.

2/ Less than 0.05 percent.

Table 17. Timber volume on commercial forest land by counties

County	State unit 1/	Live saw timber 2/	Live all timber 3/
		M board feet	M cubic feet
Beaverhead	E	2,276,123	1,288,148
Big Horn	E	113,345	71,534
Blaine	E	60,835	26,570
Broadwater	E	423,233	201,274
Carbon	E	107,615	73,058
Carter	E	111,331	33,838
Cascade	E	178,755	86,884
Chouteau	E	22,372	9,390
Custer	E	26,693	11,146
Daniels	E	42	233
Dawson	E	6,032	3,369
Deer Lodge	W	44,360	21,200
Deer Lodge	E	115,149	87,678
Fallon	E	664	183
Fergus	E	225,326	85,695
Flathead	W	8,843,064	1,882,200
Gallatin	E	2,351,088	952,423
Garfield	E	21,463	13,954
Glacier	E	49,720	20,027
Golden Valley	E	16,508	9,239
Granite	W	1,328,123	418,800
Hill	E	6,217	3,728
Jefferson	E	714,912	475,308
Judith Basin	E	323,880	120,578
Lake	W	2,406,135	537,400
Lewis & Clark	W	604,764	157,700
Lewis & Clark	E	1,462,369	595,730
Liberty	E	3,550	1,859
Lincoln	W	11,116,472	2,543,000
McCone	E	3,494	774
Madison	E	1,360,846	580,579
Meagher	E	1,630,647	673,614

Table 17. Timber volume on commercial forest land by counties (Cont.)

County	State unit 1/	Live saw timber 2/	Live all timber 3/
		M board feet	M cubic feet
Mineral	W	1,943,593	510,900
Missoula	W	4,794,840	1,160,500
Musselshell	E	273,844	105,713
Park	E	2,363,149	760,760
Petroleum	E	5,941	3,867
Phillips	E	31,562	16,361
Pondera	E	112,943	43,891
Powder River	E	209,038	78,816
Powell	W	1,366,749	404,800
Prairie	E	11,939	2,644
Ravalli	W	2,213,928	487,400
Richland	E	29,848	6,717
Roosevelt	E	1,021	357
Rosebud	E	119,066	50,682
Sanders	W	4,963,049	1,147,000
Sheridan	E	67	98
Silver Bow	W	63,685	32,700
Silver Bow	E	439,713	161,647
Stillwater	E	122,606	70,944
Sweetgrass	E	564,161	209,085
Teton	E	201,076	128,315
Toole	E	6,494	3,466
Treasure	E	19,772	7,995
Valley	E	45,849	11,367
Wheatland	E	37,509	20,799
Wibaux	E	903	315
Yellowstone	E	62,215	23,982
Eastern unit		16,270,925	7,134,634
Western unit		39,688,762	9,303,600
Total		55,959,687	16,438,234

1/ W designates counties west of the Continental Divide, and E, east of the Divide.

2/ Trees 11.0 inches and larger in diameter as measured by International 1/4" rule.

3/ The volume, excluding bark, of sound trees and the sound volume of cull trees from 1-foot stump to a 4.0-inch minimum top diameter including the sound volume of limbwood for hardwood species to a 4.0-inch minimum top diameter.

Table 18. Annual lumber production 1/

Montana

Year	Number of mills	Total reported production	Softwood										Hardwood				
			Cedar	Douglas-fir	Hemlock	Ponderosa pine	White pine	Spruce	Larch	White fir	Lodgepole pine	Other	Total	Cottonwood	Oak	Birch	Other	Total
			Thousand feet board measure															
1869	-	13,000	-	5,000	-	7,000	1,000	-	-	-	-	-	13,000	-	-	-	-	-
1879	-	21,000	-	9,000	-	10,000	2,000	-	-	-	-	-	21,000	-	-	-	-	-
1889	-	94,000	-	30,000	-	60,000	2,000	-	-	-	-	1,000	93,000	-	-	-	1,000	1,000
1899	69	255,685	-	61,931	-	153,467	4,375	415	34,197	-	-	-	254,385	-	1,300	-	-	1,300
1904	36	236,430	-	49,404	-	138,476	-	17,900	3,400	-	-	27,250	236,430	-	-	-	-	-
1905	23	189,291	3,000	6,132	5,000	101,998	20,561	155	39,089	-	-	-	175,935	-	-	-	13,356	13,356
1906	84	328,727	195	41,537	235	165,849	5,850	4,025	91,488	14,464	-	-	323,643	200	-	-	4,884	5,084
1907	130	343,814	10	34,703	-	164,746	2,615	7,936	107,684	25,999	-	-	343,693	121	-	-	-	121
1908	173	311,533	2,030	38,825	-	144,587	6,287	7,201	106,095	6,281	-	-	311,306	227	-	-	-	227
1909	179	308,582	60	43,270	-	146,890	1,671	6,837	104,130	2,647	2,567	-	308,072	510	-	-	-	510
1910	140	319,089	126	53,070	1,201	135,817	3,090	10,273	99,283	13,589	2,380	-	318,829	260	-	-	-	260
1911	126	228,416	8	36,784	-	96,654	5,311	2,803	80,145	2,917	3,348	-	227,970	446	-	-	-	446
1912	118	272,174	348	39,325	10	94,093	7,363	7,432	120,779	560	1,959	-	271,869	305	-	-	-	305
1913	109	357,974	80	63,494	298	120,414	24,606	7,623	137,703	2,330	1,199	-	357,747	227	-	-	-	227
1914	124	317,842	1,005	51,061	-	134,568	17,537	7,666	101,771	465	3,677	-	317,750	92	-	-	-	92
1915	94	324,333	-	41,464	-	118,920	27,330	13,266	115,001	6,510	1,684	-	324,175	158	-	-	-	158
1916	103	383,884	2,612	56,845	-	138,206	10,497	6,790	163,829	3,408	1,631	-	383,818	66	-	-	-	66
1917	122	347,496	25	38,600	-	150,905	4,974	6,437	135,734	9,645	986	-	347,306	190	-	-	-	190
1918	98	335,811	-	34,906	-	169,956	4,207	6,773	114,250	4,523	729	-	335,344	467	-	-	-	467
1919	125	287,378	189	40,675	29	108,548	371	34,064	101,714	576	352	-	286,518	860	-	-	-	860
1920	124	409,667	1,846	55,670	-	173,507	5,061	21,573	112,400	22,891	15,603	-	408,551	1,116	-	-	-	1,116
1921	120	213,989	-	27,762	-	102,342	710	491	81,053	29	1,320	-	213,707	282	-	-	-	282
1922	100	303,458	20	51,966	-	136,393	351	6,444	105,415	578	2,279	-	303,446	12	-	-	-	12
1923	117	426,917	101	76,002	20	167,468	7,539	12,589	159,029	1,578	2,097	-	426,423	494	-	-	-	494
1924	100	350,335	780	54,050	731	137,358	9,484	4,011	141,075	323	2,518	-	350,330	5	-	-	-	5
1925	120	388,854	757	74,003	2,683	159,238	9,915	5,368	133,393	2,233	1,254	-	388,844	10	-	-	-	10
1926	122	378,698	213	67,251	1,371	172,000	15,178	7,099	112,217	1,187	1,977	-	378,493	205	-	-	-	205
1927	126	396,267	1	79,883	8	164,197	12,623	5,979	130,647	856	2,013	-	396,207	60	-	-	-	60
1928	119	387,879	3	72,827	214	168,396	18,501	7,721	118,175	232	1,733	-	387,802	77	-	-	-	77
1929	126	388,711	36	72,830	-	170,047	21,697	16,183	104,818	213	2,842	-	388,666	45	-	-	-	45
1930	114	296,990	-	45,585	-	133,709	25,600	13,343	77,889	70	774	-	296,970	20	-	-	-	20
1931	86	158,213	37	29,469	-	64,541	17,857	3,661	41,792	110	741	-	158,208	-	-	5	-	5
1932	72	111,048	-	15,795	-	54,897	2,705	4,492	32,620	30	479	-	111,018	30	-	-	-	30
1933	89	125,126	20	13,693	-	72,196	4,776	9,241	24,527	35	638	-	125,126	-	-	-	-	-
1934	105	171,841	-	26,473	-	79,549	7,092	7,298	50,189	100	989	-	171,690	151	-	-	-	151
1935	116	233,633	5	34,039	-	114,454	15,384	12,089	56,336	40	1,228	-	233,575	58	-	-	-	58
1936	126	295,233	100	51,395	-	130,507	23,669	13,510	74,241	837	974	-	295,233	-	-	-	-	-
1937	146	335,045	100	57,899	-	154,709	20,186	14,772	84,686	1,332	1,354	-	335,038	7	-	-	-	7
1938	140	221,579	36	39,929	16	106,902	21,163	6,373	45,439	357	1,350	-	221,565	14	-	-	-	14
1939	168	271,096	103	39,240	-	130,060	29,939	5,447	63,738	222	2,202	-	270,951	130	-	15	-	145
1940	168	325,338	154	62,336	-	145,684	26,962	12,386	75,493	87	2,213	-	325,315	23	-	-	-	23
1941	265	373,970	12	86,518	-	166,100	18,135	13,010	87,549	711	1,902	-	373,937	33	-	-	-	33
1942	249	433,089	-	96,663	5	177,497	18,707	20,584	117,311	56	2,244	-	433,067	22	-	-	-	22
1943	228	423,520	25	75,953	-	173,622	9,618	16,996	145,396	161	1,680	-	423,451	69	-	-	-	69
1944	256	448,498	38	89,720	-	180,042	9,048	26,365	140,985	5	2,217	-	448,420	78	-	-	-	78
1945	253	341,749	-	67,532	-	144,346	3,815	13,824	110,092	425	1,589	-	341,623	126	-	-	-	126
1946	401	413,859	17	99,573	-	150,405	7,699	11,933	138,900	142	4,820	-	413,489	368	-	2	-	370
1947	407	499,959	82	114,147	140	200,923	6,145	9,836	162,438	1,356	4,674	-	499,741	216	-	-	2	218
1948	434	597,944	1,068	210,896	196	223,569	13,464	16,705	129,259	106	2,619	-	597,882	60	-	-	2	62

1/ Source: U.S.D.A. Misc. Publ. 669, 1869 - 1946; U.S.D.C., Bureau of Census, Census of Manufactures 1947; and Forest Service 1948.

Table 19. Lumber production and number of active sawmills - 1921-1948 1/

Mill size 2/	1921	1926	1931	1936	1941	1946	1947	1948
				LUMBER PRODUCTION				
				Thousand feet, board measure				
Large	160,878	286,934	124,288	188,176	242,375	158,725	202,063	208,930
Medium	32,843	71,181	21,540	84,346	90,379	192,905	226,953	286,386
Small	21,187	21,448	13,663	24,344	41,216	62,229	70,943	102,628
Total	214,908	379,563	159,491	296,866	373,970	413,859	499,959	597,944
				Percent of total				
Large	75	76	78	63	65	38	41	35
Medium	15	19	14	29	24	47	45	48
Small	10	5	8	8	11	15	14	17
Total	100	100	100	100	100	100	100	100
				NUMBER OF ACTIVE SAWMILLS				
Large	7	7	5	5	4	3	4	5
Medium	12	19	7	17	28	67	77	87
Small	140	135	127	176	233	331	326	342
Total	159	161	139	198	265	401	407	434

1/ Total production and number of sawmills for 1921, 1926, 1931, and 1936 exceeds production shown in table because of the addition of production of mills which cut less than 50 M feet, board measure, in these years.

2/ Large mills cut 10,000 M feet, board measure, and over; medium mills 1,000 M to 9,999 M feet, board measure; and small mills 999 M feet, board measure, and less.

Table 20. Lumber production and number of active sawmills by mill-size class 1/ - 1945-1947

Mill-size class	Size-class production	Total production 2/			Number of active sawmills		
		1945	1946	1947	1945	1946	1947
	Thousand feet, board measure						
0	1 through 49	1,811	2,332	1,799	76	101	80
1a	50 " 199	6,482	13,657	14,716	64	129	135
1b	200 " 499	11,048	20,548	20,725	38	65	65
2	500 " 999	14,315	25,692	33,703	22	36	46
3a	1,000 " 2,999	53,115	71,931	85,453	31	43	48
3b	3,000 " 4,999	39,943	50,950	67,845	10	14	18
4	5,000 " 9,999	52,268	70,024	73,655	8	10	11
5	10,000 " 14,999	162,767	--	202,063	1	0	1
6	15,000 " 24,999	xx	--	--	1	0	--
7	25,000 " 49,999	--	158,725	xx	0	1	1
8	50,000 " over	xx	xx	xx	2	2	2
Total		341,749	413,859	499,959	253	401	407

1/ Data from Bureau of Census releases.

2/ To avoid disclosing operations of individual establishments, production is omitted in certain size classes. The omission is indicated by "xx" and the production is combined with the size class above which is underscored.

Table 21. Annual pole production. Montana, 1937, 1946-1949

Species	1937	1946	1947	1948	1949
			-Number of poles-		
Lodgepole pine	3,214	265,877	269,141	114,705	172,108
Western redcedar	24,425	8,769	16,984	17,841	15,408
Western larch	--	26,476	32,704	29,695	32,546
Douglas-fir	1,608	--	5,905	4,615	1,753
Miscellaneous	--	200	--	--	--
Total	29,247	301,322	324,734	166,856	221,815

Table 22. Annual production of Christmas trees, cross ties, shingles, and lath - 1925-1949

Year	Christmas trees	Sawed cross ties 1/	Shingles	Lath
	No. of trees	No. of pieces	No. of squares	M pieces
1925	-	1,225,000	3,387	32,209
1926	-	-	481	32,306
1927	-	1,054,796	300	19,419
1928	-	959,175	252	15,416
1929	-	915,895	210	17,003
1930	-	824,515	666	14,488
1931	-	613,143	385	6,741
1932	-	670,000	447	4,362
1933	-	525,000	430	7,449
1934	-	-	750	8,705
1935	-	-	1,587	10,416
1936	1,242,500	-	6,111	13,481
1937	1,534,500	-	3,366	16,869
1938	1,676,000	554,540	5,912	11,856
1939	1,967,350	-	10,608	12,530
1940	2,338,350	1,237,668	12,512	11,747
1941	3,082,650	1,398,968	12,410	11,466
1942	2,203,750	2,319,978	9,491	11,691
1943	3,102,480	2,239,584	3,081	8,024
1944	2,755,750	2,090,428	425	7,300
1945	2,723,500	1,302,238	1,024	2,680
1946	3,299,400	1,008,619	1,942	5,361
1947	2,515,640	1,336,555	-	-
1948	3,098,886	-	-	-
1949	3,256,956	-	-	-

Dash indicates data are not available for these years.

1/ Production of sawed cross ties is included in total volume of lumber production, table

Table 23. Distribution of Montana lumber shipments - 1924-1945

Area	State	1924	1936 1/	1938 2/	1945 3/
		Thousand feet, board measure			
Montana	Montana	118,249	169,732	134,673	192,934
West	Arizona	-	-	-	61
	California	69	-	5	575
	Colorado	10,562	3,044	1,780	3,947
	Idaho	2,090	3,971	1,703	3,886
	Nevada	-	-	-	15
	New Mexico	-	-	-	119
	Oregon	-	63	-	-
	Utah	2,166	1,938	2,338	7,580
	Washington	1,738	3,081	122	4,843
	Wyoming	6,397	3,489	5,129	2,402
Subtotal		23,022	15,586	11,077	23,428
Middle west	Illinois	35,709	16,830	14,572	24,920
	Indiana	745	857	848	3,721
	Iowa	15,473	11,696	12,597	12,336
	Kansas	2,619	381	647	2,361
	Michigan	12,130	8,136	3,437	7,971
	Minnesota	37,019	13,059	7,950	29,430
	Missouri	4,866	2,974	2,956	3,557
	Nebraska	10,309	2,677	1,698	4,880
	North Dakota	5,282	13,205	2,040	10,000
	Ohio	1,945	3,048	3,686	2,722
	South Dakota	3,569	949	1,021	2,801
	Wisconsin	11,798	4,610	3,278	11,758
Subtotal		141,464	78,422	54,730	116,457
Northeast	Connecticut	7,061	3,273	2,879	1,109
	Delaware	-	178	355	-
	Maine	69	90	178	904
	Maryland & D.C.	48	548	627	299
	Massachusetts	1,526	1,762	720	476
	New Hampshire	192	103	21	61
	New Jersey	775	3,513	3,891	1,615
	New York	10,905	9,210	8,947	4,704
	Pennsylvania	13,590	6,828	5,798	11,530
	Rhode Island	263	237	148	167
	Vermont	165	109	105	34
	West Virginia	1,563	123	153	155
Subtotal		36,157	25,974	23,822	21,054

Table 23. Distribution of Montana lumber shipments (Cont.)

Area	State	1924	1936 1/	1938 2/	1945 3/
		- - - - -Thousand feet, board measure- - - - -			
South	Alabama	-	20	26	20
	Arkansas	-	-	-	-
	Florida	-	-	-	48
	Georgia	-	-	-	-
	Kentucky	-	-	3	304
	Louisiana	-	-	-	-
	Mississippi	-	-	-	103
	North Carolina	-	-	26	-
	Oklahoma	145	49	71	1,251
	South Carolina	-	-	-	-
	Tennessee	25	25	12	29
	Texas	-	25	9	687
	Virginia	25	63	429	172
Subtotal		195	182	576	2,614
Total domestic		319,087	289,896	224,878	356,487
Exports		-	-	18	990
Total		319,087	289,896	224,896	357,477

1/ U.S.D.A., Forest Service, Lumber Distribution and Consumption for 1936, by Reynolds and Pierson, 1938, table 5, page 19.

2/ U.S.D.A. Misc. Publication 413, table 12, page 26.

3/ U.S.D.A., Forest Service, Distribution of Lumber from Sawmills in Western States, 1945, by Gordon D. Merrick. October 1947. Table III.

FOREST SURVEY METHOD

AREA

Forest area estimates for land west of the Continental Divide, for four counties east of the Divide, and for reserved land were determined by a complete survey. All other sections of the State were sampled for forest area or were eliminated as nonforest zone. Large blocks of nonforest were eliminated by the use of aerial photographs and field examination.

Class of land	Complete survey	Sampling survey	Eliminated	Total
		--Thousand acres--		
Forest land				
Commercial	9,882	5,874	--	15,756
Noncommercial	2,629	1,447	--	4,076
Reserved	2,527	--	--	2,527
Total forest land	15,038	7,321	--	22,359
Nonforest land	10,230	10,828	50,225	71,283
Total land	25,268	18,149	50,225	93,642

For land covered by the complete survey the area was classified and determined as follows: Using intensive private and public timber cruises, county land records, cutting and fire records, and aerial photographs, preliminary cover classifications were made in the office. Subsequently the office determinations were checked and supplemented by field examination. Cover types were delineated on base maps and symbols were used to designate for each type the tree species composition, stand condition, stocking, site, and age classes. From maps the area of the various cover classes within each ownership was calculated by the use of zylonite shields lined in 10-acre subdivisions or by planimeter. The area data were tabulated by Land Office sections and summarized by counties.

The area sampled was classified into three categories (1) portions inside national forest boundaries, (2) portions outside national forest boundaries for which aerial photographs were available, and (3) portions outside national forest boundaries either not covered by aerial photographs or where photo costs were prohibitive. The area sample for category 1 consisted of four-section blocks

(2560 acres) spaced at four-mile intervals; for categories 2 and 3 one-section blocks (640 acres) spaced at seven-mile intervals for category 2 and ten-mile intervals for category 3. The sum of these area blocks constituted the sample. Each block was examined in the field and the area classified and mapped by commercial character, cover type, stand size, stocking, age, and site. In the office the area of the cover classes for each sample was determined by dot or square counting. The data were summarized by sample categories and expanded to include the total area sampled.

VOLUME

For the area covered by complete survey, board-foot estimates for saw-timber trees in saw-timber stands were derived from (1) national forest cruises, (2) other public and private cruises adjusted to a common standard by factors based on check cruises, and (3) ocular estimates made by field men while mapping cover types. Cubic-volume estimates of saw-timber trees in saw-timber stands were calculated from board-foot volumes by the use of ratios based on woods-scale studies. The volume of the pole-tree element in saw-timber stands was derived from mean-acre volumes by types, based on check-cruise tallies. The board- and cubic-foot volume of nonsaw-timber stands was calculated from modified normal yield tables. Yield-table modifications were based on 411 1/4-acre samples measured throughout the nonsaw-timber stands at 2-mile intervals along roads and trails. All board-foot volumes, initially calculated in terms of Scribner Rule, were converted to International 1/4-inch log rule by means of factors derived from mill-scale studies.

For the sampled area, total volume was derived from mean-acre volumes and area by sample class, forest type, stand-size, and stocking classes. Mean volumes were based on tree tallies on 2,713 1/5-acre permanent sample plots — a cluster of 2 or 3 plots in each sample-area segment containing commercial forest land. Three-plot clusters were measured in sample class 1 and two-plot clusters in sample classes 2 and 3 (see area discussion). Within a cluster, plots were spaced 5 chains apart, the initial plot being 2 chains in a random direction from the control point of that sample-area segment. Plot centers were staked and referenced to two scribed witness trees to facilitate future location and remeasurement.

GROWTH

For the area covered by complete survey only net growth was determined. For that purpose the forest area was arbitrarily classified into (1) nongrowing stands in which experience indicated that gross growth generally was offset by mortality and (2) growing stands in which gross growth generally exceeded mortality. Category (2) consisted of all uncut stands of ponderosa pine, larch, and Douglas-fir less than about 200 years of age, uncut stands of other species less than about 160 years, and partially cut stands of all species regardless of age. Average net growth per acre by type, stand-size, age, stocking, and site classes was derived from modified normal growth tables. Modification of normal tables was based on actual net growth as determined from increment borings and mortality tallies on 375 1/5-acre sample plots covering the range of age, stocking, and site classes within types.

Gross and net growths for the area sampled were derived from increment borings of sample trees and mortality tallies on each sample plot measured for inventory purposes. Three sample-plot sizes were used to measure growth: 1/500 acre for trees 5.0 inches to 10.9 inches d.b.h., 1/50 acre for trees 11.0 inches to 24.9 inches d.b.h., and 1/5 acre for trees 25.0 inches d.b.h. and larger. Radial growth was determined for the 10-year period preceding the date of field examination. Radial growth was converted to volume growth by subtracting the reconstructed volume of sample trees 10 years ago, taking into account changes in height and bark thickness as well as diameter, from current sample tree volume. For the total growth determination sample trees were divided into two classes (1) ingrowth trees — those that either developed from sapling into pole size or that grew out of pole size into saw-timber size, and (2) main-growth trees — those that remained either of pole size or of saw-timber size during the growth-study decade. Total ingrowth was derived by multiplying the mean ingrowth per acre by the appropriate area by type, stand-size, and stocking classes. Main growth was calculated from simple growth percents and total inventory volumes by type, stand-size, stocking, species, and diameter classes.

COMMODITY DRAIN

Commodity drain for both sampled and complete survey areas is based chiefly on the reports of producing or consuming industries, with adjustments for waste as determined from woods and mill-scale studies. Approximately 88 percent of the board-foot drain estimates were derived from a complete canvass of sawmills, pulpmills, pole manufacturers, railroads, and mines. The remaining portion, consisting chiefly of drain for posts and fuelwood, was derived in part from production and sales reports, and in part from consumption ratios and urban and rural population statistics.

MORTALITY

Mortality in growing stands of the area covered by complete survey was based on a tally of trees judged to have died within the 10-year period of the growth study. Mortality of nongrowing stands was derived by applying the mortality percent of growing stands to the volume of nongrowing stands.

Mortality for the sample survey was based on a tally of trees judged to have died during the last half of the growth-study period (5 years) on each 1/5-acre plot sampled for inventory. The five-year mortality was doubled to obtain mortality for the entire growth-study period.

ACCURACY OF ESTIMATES

AREA

In determining the extent of various cover types and stand-condition classes there are two possible sources of error (1) errors in classifying the cover of the field samples and in compiling the field data, and (2) sampling errors. The former result from mistakes of judgment or technique and the complexity of the cover which not infrequently grades from one class into another with no clearly defined boundaries. These errors were minimized by the exercise of care and skill, but it is seldom possible to evaluate them. An effort was made to maintain a high order of accuracy and uniformity of standards in the classification, collection, and compilation of sample data by field checks, by a continuing program of training, and by cross checks in the office.

Sampling errors (standard errors of estimate), on the other hand, do not involve human errors, but rather are theoretical measures of the reliability of estimates based on the variability exhibited by sample measurements. They generally vary inversely with the square root of the number of samples and directly with the square root of the unsampled proportion of the total population. Hence, they can be controlled by altering either the number of samples, the size of individual samples, or both.

Area estimates for the portion covered by complete survey have no sampling errors. Such technique errors that may have occurred in spite of all reasonable precautionary measures are small or negligible. Analysis of sample variations for the portion covered by sampling indicates that the standard errors of estimate are ± 2.0 percent for total, ± 2.5 percent for commercial, and ± 4.4 percent for noncommercial forest land areas. Accordingly, the probabilities are 2 out of 3 that for the areas sampled the actual total, commercial, and noncommercial forest land areas are, respectively, within ± 146,000, ± 152,000, and ± 63,000 acres of the estimates, if measurements and computing errors introduced no bias.

For the State as a whole, considering sampling and technique errors for the sampled portion and technique errors for the portion covered by complete survey, it is judged that actual areas lie between the following limits:

Forest land	Million acres
Total	22.3 to 22.5
Commercial	15.7 to 15.9
Noncommercial and reserved	6.5 to 6.7

VOLUME

In determining timber volume the possible sources of errors, in addition to those cited under "area" include inaccurate measurement of sample plots, tree diameters, tree heights, cull, and bias resulting from the improper construction, selection, and use of tree-volume tables. All reasonable effort was made to eliminate errors from these sources.

Comparison of survey volumes and cutting records indicates that the volume estimates for the area covered by complete survey are slightly low. No allowance has been made for this possible bias. Standard errors of estimate for the portion covered by sampling are ± 3.2 percent or ± 212 million cubic feet for the primary growing stock estimate, ± 9.0 percent or ± 1,397 million board feet for the live saw-timber estimate.

For the State as a whole it is judged that the volume estimates lie within the following limits:

Primary growing stock	16 to 17 billion cubic feet
Live saw timber	55 to 58 billion board feet

GROWTH

In estimating timber growth the possible sources of error, in addition to those cited under "area" and "volume," include errors in measuring increment cores, in reconstructing tree volumes, and in dating mortality. All practical efforts were made to eliminate errors from these sources. Growth estimates for the portion covered by complete survey are believed to be somewhat low. As mentioned under "methods," the original growth calculation for this portion of the State excluded approximately one third of the commercial area where the stands were in a more or less static condition with regard to volume. It appears now that there may have actually been some net growth in these stands during recent years.

For the area sampled, standard errors of net growth are ± 8.4 percent or ± 11 million cubic feet for primary growing stock, ± 15 percent or ± 36 million board feet for live saw-timber trees.

Actual growth for the State as a whole is judged to lie between limits as follow:

	Million
Gross growth primary growing stock	290 to 320 cu. ft.
Net growth primary growing stock	240 to 280 cu. ft.
Gross growth live saw-timber trees	840 to 930 bd. ft.
Net growth live saw-timber trees	600 to 700 bd. ft.

COMMODITY DRAIN

Estimates of commodity drain are based chiefly on a complete tabulation of production and consumption statistics, adjusted for waste on the basis of woods and mill studies. Only 18 percent of the cubic-foot and 12 percent of the board-foot drain are based on sampling. The translation of production statistics into drain, however, introduces an indeterminable error. The commodity drain estimates for the State as a whole are judged to be between 90 and 100 million cubic feet of primary growing stock and between 520 and 550 million board feet of saw-timber volume.

DEFINITIONS

Following are definitions of terms used in this report:

FOREST COVER CLASSES

1. Forest land - Includes (a) lands which are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking and which have not been developed for other use; and (c) afforested areas. The minimum area for forest land classification was 10 acres with a minimum width of 120 feet.

2. Commercial forest land - Forest land which is (a) producing, or physically capable of producing, usable crops of wood (usually saw timber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization.

3. Reserved forest land - Forest land that has been withdrawn from timber utilization through statute, ordinance, or administrative order.

   a. Reserved commercial forest land - Reserved forest land that otherwise qualifies as commercial forest land.

   b. Reserved noncommercial forest land - Reserved forest land that otherwise qualifies as noncommercial forest land.

FOREST STAND-SIZE CLASSES

1. Saw-timber stands - All stands with saw-timber trees of softwoods and/or hardwoods having a minimum volume of 1,500 board feet per acre, International 1/4-inch log rule.

2. Pole-timber stands - Stands failing to meet the saw-timber stands specification, but at least 10-percent stocked with pole-timber and larger (5.0 inches d.b.h. and larger) trees and with at least half the minimum stocking in pole-timber trees.

3. Seedling-sapling stands - Forest stands not qualifying as either saw-timber or pole-timber stands, but having at least 10-percent stocking of trees and with at least half the minimum stocking in seedlings and saplings.

4. Nonstocked and other areas not elsewhere classified - Areas not qualifying as saw-timber, pole-timber, or seedling-sapling stands.

FOREST TYPE CLASSES

1. Douglas-fir - Forests in which 50 percent or more of the stand is Douglas-fir and less than 20 percent is western white pine.

2. Ponderosa pine - Forests in which 50 percent or more of the stand is ponderosa pine and less than 20 percent is western white pine.

3. White pine - Forests in which 20 percent or more of the stand is western white pine.

4. Larch - Forests in which 50 percent or more of the stand is larch and less than 20 percent is western white pine.

5. Hemlock-grand fir - Forests in which 50 percent or more of the volume is grand fir, alpine fir, or western hemlock, singly or in combination, and less than 20 percent is western white pine.

6. Lodgepole pine - Forests in which 50 percent or more of the stand is lodgepole pine and less than 20 percent is western white pine.

7. Spruce-fir - Forests in which 50 percent or more of the stand is true fir (Abies spp.), Engelmann spruce, Colorado blue spruce, western white spruce, or mountain hemlock, singly or in combination, and western white pine comprises less than 20 percent of the stand.

8. Western redcedar - Forests in which 50 percent or more of the stand is western redcedar and less than 20 percent is white pine.

9. Coniferous woodland - Open scraggly commercial forests in which 50 percent or more of the stand is juniper and/or ponderosa pine.

10. Hardwoods - Forests in which 50 percent or more of the stand is hardwood species and less than 20 percent is western white pine.

OWNERSHIP CLASSES

1. National forest ownership - Federal lands which, by executive order or statute, have been designated as national forests, purchase units, or experimental areas or have been placed under the administration of the Forest Service.

2. Indian ownership - Indian tribal lands and trust allotments. Lands held in fee by the federal government but administered and managed for Indian tribal groups, or allotted in trust to individual Indians.

3. Other federal ownership - Lands owned by the federal government not classed as national forest or Indian.

4. State ownership - Lands in state ownership.

5. County and municipal ownership - Lands in county or municipal ownership.

6. Private ownership - Lands in private ownership.

7. Private farm ownership - Private commercial forest land in farms, using as the definition of farm the official definition in the latest Census of Agriculture.

8. Other private ownership - Commercial forest land in private ownership other than farm.

TREE-MERCHANTABILITY CLASSES (LIVE)

1. Sound saw-timber trees - Live white pine saw-timber trees in which the merchantable proportion is 40 percent or more of the total board-foot volume; live saw-timber trees of other species that are at least 50 percent merchantable by board-foot volume.

2. Cull saw-timber trees - Live white pine trees in which the unmerchantable proportion exceeds 60 percent and live trees of other species in which the unsound portion exceeds 50 percent of total board-foot volume.

   a. Sound cull saw-timber trees - Live trees in which the unmerchantable portion results from defect other than rot; for example, sweep, frost crack, extreme roughness, fire scar, etc.

b. Rotten cull saw-timber trees - Live trees in which the unmerchantable portion results from decay organisms.

3. Sound pole trees - Live pole trees of all species that are judged to be prospectively merchantable for sawlogs.

4. Cull pole trees - Live pole trees of all species that are judged to be prospectively unmerchantable for sawlogs.

   a. Sound cull pole trees - Live pole trees judged unmerchantable now or prospectively because of defect other than rot.

   b. Rotten cull pole trees - Live pole trees judged unmerchantable now or prospectively because of rot.

TREE-MERCHANTABILITY CLASSES (DEAD)

1. Sound saw-timber trees - Dead (standing or down) saw-timber trees of all species having a merchantable volume of 50 percent or more of the total board-foot volume.

2. Sound pole trees - Dead (standing or down) pole trees of all species with 50 percent or more of the cubic volume merchantable.

TREE-SIZE CLASSES

1. Saw-timber trees - Trees 11.0 inches d.b.h. and larger with one or more merchantable 16-foot sawlog.

2. Pole trees - Trees ranging from 5.0 inches through 10.9 inches d.b.h. and trees over 11.0 inches d.b.h. that do not contain at least one merchantable 16-foot sawlog.

3. Seedling-sapling trees - Trees below 5.0 inches d.b.h.

MISCELLANEOUS DEFINITIONS

1. Primary growing stock - Net volume, in cubic feet, of live saw-timber trees, and live pole-timber trees from stump to a minimum 4.0-inch top (of central stem) inside bark.

2. Secondary growing stock - Net volume in cubic feet of all cull trees from stump to a minimum 4.0-inch top inside bark; and net volume limbs to a 4.0-inch diameter inside bark of all cull and noncull hardwood trees.

3. All-timber volume - The net volume of primary growing stock, secondary growing stock, and the net volume of salvable dead trees.

4. Sawlog portion - The net board-foot volume, as measured by International 1/4-inch log rule, of sound saw-timber trees from stump to a merchantable sawlog top. Tops vary by species and diameter class, ranging from 6.0 inches for small trees up to 22 inches for very large rough trees.

5. Top portion - The net portion of saw-timber trees from the merchantable sawlog top to 4.0 inches inside bark.

6. Live pole-tree volume - The net cubic-foot volume of live pole trees from stump to a 4.0-inch top inside bark.

7. Net board-foot volume - The board-foot volume of the sawlog portion of sound saw-timber trees, as measured by International 1/4-inch log rule, after deduction for all apparent and surmised defect in accordance with standard scaling practice.

8. Net cubic volume - The total cubic volume discounted for unmerchantable material; includes the merchantable portion only of sound, sound cull, and rotten cull saw-timber and pole trees and hardwood limbs larger than a 4.0-inch top diameter.

9. Net growth - The mean periodic increment based on the decade preceding field examination, less the mean periodic mortality for the same period. Gross growth is the increment before allowance for mortality.

10. D.B.H. (diameter breast high) - Tree diameter in inches, outside bark, measured 4-1/2 feet above average ground level.

11. Commodity production - The volume of timber harvested for commodity use as expressed in commercial terms.

12. Commodity drain - The commodity production adjusted for woods and mill waste, etc., to conform with Forest Survey utilization standards.

13. Control point - Land Office section corners (in unsurveyed areas idealized section corners as indicated on latest base map) used to locate and define the boundaries of sampling strata and sample segments.

LIST OF FOREST SURVEY REPORTS FOR MONTANA

No.	Forest Survey Statistical Service Series
2	Forest statistics for Lincoln County, 1941
3	Forest statistics for Flathead County, 1941
4	Forest statistics for Lake County, 1941
5	Forest statistics for Sanders County, 1941
6	Forest statistics for Mineral County, 1941
7	Forest statistics for Ravalli County, 1941
8	Highlights of the Missoula County forest situation, 1942
9	Highlights of the forest situation in Lewis and Clark County (west of the Continental Divide), 1942
10	Highlights of the forest situation in Deerlodge County (west of the Continental Divide), 1942
11	Highlights of the forest situation in Silver Bow County (west of the Continental Divide), 1942
12	Highlights of the Powell County forest situation, 1942
13	Highlights of the Granite County forest situation, 1942
14	Highlights of the forest situation in western Montana, 1943
15	*Highlights of the forest situation in Chouteau County, 1943
16	*Highlights of the forest situation in Fergus County, 1943
17	*Highlights of the forest situation in Judith Basin County, 1943
18	Highlights of the forest situation on the national forests of western Montana, 1944
	Forest Survey Releases
20	*The forest situation in Lincoln County, July 1943
21	The forest situation in Ravalli County, July 1943
	Station Papers
12	Forest resource statistics Cascade County, by H.J.Pissot and E. F. Peffer, April 1948
13	Forest resources of Northern Montana, by C. W. Brown and W.C. Hodge, June 1948
20	Forest resources of Southern Montana, by W. C. Hodge, C. W. Brown, and T. L. Finch, May 1949
23	Forest resources of South Central Montana, by T. L. Finch, W. C. Hodge, and M. E. Metcalf, April 1950
25	Montana forest resource and industry statistics, by Paul D. Kemp and M. B. Dickerman, October 1950

* Out of print. Loan copies may be obtained upon request.

LIST OF PREVIOUS PUBLICATIONS IN THIS SERIES

Station Paper No.	
1	* A preliminary study of root diseases in western white pine, by John Ehrlich. Oct. 1939.
2	* Possibilities of partial cutting in young western white pine, by E. F. Rapraeger. Jan. 1940.
3	Blister rust control in the management of western white pine, by Kenneth P. Davis and Virgil D. Moss. June 1940.
4	Possibilities of wood-pulp production in the northern Rocky Mountain region, by E. F. Rapraeger. Mar. 1941.
5	Results to date of studies of the durability of native woods treated and untreated, by C. N. Whitney. Rev. Jan. 1946.
6	Changes in Benewah County forest statistics, by Paul D. Kemp. July 1947.
7	A guide for range reseeding on and near the national forests of Montana, by C. Allan Friedrich. Oct. 1947.
8	Pole blight - a new disease of western white pine, by C. A. Wellner. Nov. 1947.
9	Management practices for Christmas tree production, by C. A. Wellner and A. L. Roe. Nov. 1947.
10	The merits of lodgepole pine poles, by I. V. Anderson. Nov. 1947.
11	Tables for approximating volume growth of individual trees, by P. D. Kemp and M. E. Metcalf. Mar. 1948.
12	Forest resource statistics, Cascade County, Montana, by H. J. Pissot and E. F. Peffer. Apr. 1948.
13	Forest resources of northern Montana, by C. W. Brown and W. C. Hodge. June 1948.
14	List of publications available for distribution or loan, 1910 through 1947. NRM station. June 1948
15	Review of published information on the larch-Douglas fir forest type, by Russell K. LeBarron. Nov. 1948.
16	Development of a blister rust control policy for the national forests in the Inland Empire, by Donald N. Matthews and S. Blair Hutchison. Dec. 1948.

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Station Paper No.	
17	Disintegration of girdled western hemlock and grand fir, by Austin E. Helmers. December 1948.
18	Suggested Montana Douglas-fir Christmas tree standards, by S. Blair Hutchison and Ben M. Huey. January 1949.
19	The possibilities of modifying lightning storms in the Northern Rockies, by Vincent J. Schaefer. January 1949.
20	Forest resources of southern Montana, by W. C. Hodge, C. W. Brown and T. L. Finch. May 1949.
21	Forest resources of Northeast Washington, by Paul D. Kemp and H. J. Pissot. May 1949.
22	Bibliography of ponderosa pine, by A. L. Roe and K. N. Boe. March 1950.
23	Forest resources of south central Montana, by T. L. Finch, W. C. Hodge, and M. E. Metcalf. April 1950.
24	The cubic foot as a national log-scaling standard, by E. F. Rapraeger. June 1950.

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